

## GLOSSARY

**Adiabatic:** occurring without loss or gain of heat.

**Alcohol:** a hydrocarbon in which one atom of hydrogen has been substituted by a hydroxyl group (e.g., methane, a hydrocarbon, is  $\text{CH}_4$  while methanol, an alcohol is  $\text{CH}_3\text{OH}$ ; the "OH" being the hydroxyl group).

**Aromatics:** high octane blending components that have a benzene ring in their molecular structure. Commonly used term for the BTX group (benzene, toluene, xylene). Aromatics are hydrocarbons.

**Azeotrope:** a liquid mixture that is characterized by a constant minimum or maximum boiling point which is different than that of any of the components. Azeotropes distill without change in composition.

**Benzene Ring:** structural arrangement of atoms believed to exist in benzene and other aromatic compounds showing six carbon atoms in symmetrical hexagonal fashion.

**Btu:** British thermal unit, i.e., the amount of heat required to raise the temperature of 1 lb. of water  $1^\circ\text{F}$  under one stated condition of pressure (1 atm) and temperature (from  $60^\circ$  to  $61^\circ\text{F}$ ).

**Butanethiol:** a substance with a strong, offensive and unique odor, used as a fuel malodorant to provoke instant recognition by the public as methanol.

**Calorie (cal):** the energy required to heat 1 gram of water  $1^\circ\text{C}$  (from  $14.5^\circ$  to  $15.5^\circ\text{C}$ , 1 atm.). One kilocalorie (1 k cal) = 1000 cal. One calorie is also defined as equal to 4.184 joules.

**Celsius (Centigrade):** a temperature scale commonly used in the sciences; at sea level, water freezes at  $0^\circ\text{C}$  and boils at  $100^\circ\text{C}$ .  $^\circ\text{C} = 5/9 (^\circ\text{F} - 32)$ .

**Cetane Number (Rating):** measure of a fuel's ease of self-ignition; the higher the number the better the fuel for a diesel engine (i.e., the percentage by volume of the hydrocarbon cetane ( $\text{C}_{16}\text{H}_{34}$ ) in a mixture of cetane and 1-methylnaphthalene that gives the same ignition lag as the fuel oil being tested).

**Combustion:** an exothermic chemical reaction of a fuel with oxygen, often intended for the direct production of heat.

**Combustion Air:** the air fed to a fire to provide oxygen for combustion of fuel. Air is essentially 79% nitrogen and 21% oxygen by volume. Combustion air may be preheated before injection into an engine.

**Combustion Efficiency:** the efficiency computed by dividing the actual heat produced in the engine by the total heat potential of the fuel consumed.

**Compression Ratio (CR):** the maximum cylinder volume divided by the minimum cylinder volume.

**Corrosion:** a gradual wearing away or alteration by a chemical or electrochemical.

**Denaturant:** a substance added to ethanol to make it unfit for human consumption so that it is not subject to alcohol beverage taxes.

**Denature:** the process of adding a substance to ethanol to make it unfit for human consumption; the denaturing agent may be gasoline or other substances specified by the Bureau of Alcohol, Tobacco and, Firearms.

**Distillation Curves:** the reference to plotting a line connecting the percentages of gasoline that evaporate at various temperatures. Distillation curve is used as an important control for fuel volatility (vaporization) standards.

**Enthalpy Requirement:** the additional heat input required by the engine's fuel induction system to achieve the required degree of fuel vaporization for smooth operation.

**Equivalence Ratio:** measure of the actual fuel/air mixture to the stoichiometric fuel/air ratio.

**Exhaust Gas Recirculation (EGR):** the recirculation of exhaust gases to the combustion chamber to reduce the peak combustion temperature for the reduction of NO<sub>x</sub> emissions.

**Exothermic:** chemical change accompanied by a liberation of heat.

**Fahrenheit Scale:** a temperature scale in which the boiling point of water is 212 and its freezing point 32°; at sea level  $^{\circ}\text{F} = 9/5^{\circ}\text{C} + 32$ .

**Formic Acid:** a colorless, pungent liquid acid (HCOOH) that is made by acidification of sodium formate. Formerly obtained from ants, spiders, etc. Synthetically, it is formed in the combustion chamber during the combustion of methanol or water-contaminated ethanol. Also known as methanoic acid.

**High Molecular Weight/Long Chain Alcohols:** with respect to transportation liquid fuels, these are alcohols that have more than 4 carbon atoms (i.e., C<sub>5</sub> and above) in their molecular structure and their main use may be as additives and cosolvents in methanol to prevent phase separation and as corrosion preventives. They include n-decanol, n-hexanol, and n-octanol.

**Hydrocarbon:** a compound composed of carbon and hydrogen atoms.

**Hydrogen Bond:** a bond between the hydrogen atom of one molecule and a pair of unshared electrons on the electronegative atom of another molecule.

**Hydroxyl:** the chemical group or ion OH that consists of one atom of hydrogen and one of oxygen, is neutral or positively charged and is characteristic especially in alcohols, oxygen acids, glycols, phenols, and hemiacetals.

**Joule (J):** the amount of energy produced by 1 W in 1 second. This is equivalent to one newton of force over a distance of 1 m. One joule = 0.239 cal.

**Latent Heat of Vaporization:** the amount of heat required to vaporize a unit quantity of a fuel, generally measured at one atmosphere of pressure and at the boiling point of that liquid.

**Low Molecular Weight/Short Chain Alcohols:** with respect to transportation liquid fuels, these are alcohols that have from 1 to 4 carbon atoms (i.e.,  $C_1$  -  $C_4$ ) in their molecular structure and include methanol, ethanol, propanol and butanol.

**Maximum Brake Torque (MBT):** the timing associated with a particular fuel for a particular combustion chamber; aside from the fuel/air mixture, the moment of ignition has the greatest influence on pollutant emissions.

**Mole (symbol "mol"):** the quantity of a chemical substance that has a weight in mass units numerically equal to the molecular weight. In chemistry, moles are used as the standard unit of measure and for the comparison of compounds. The mass units must be specified, i.e., atoms, electrons, kilograms, etc.

**Nigrosine:** a dye, to be added in small amount (up to 15% volume) to methanol to enhance the luminosity of methanol flame.

**Octane Number (Rating):** a measurement term used to identify the ability of a fuel to resist spontaneous combustion; the lower the octane rating the greater the tendency for a fuel to prematurely ignite due to heat and compression inside the cylinder and cause engine "knock."

- **Motor Octane:** the octane as tested in a single cylinder octane test engine at more severe operating conditions. Motor Octane Number affects high speed and part throttle knock and performance under load, passing, climbing hills, etc. Motor Octane is represented by the designation M in the  $(R+M)/2$  equation and is the lower of the two numbers.
- **Pump Octane:** a term used to describe the octane as posted on the retail gasoline dispenser as  $(R+M)/2$  and is the same as Antiknock Index.
- **Research Octane:** the octane as tested in a single cylinder octane test engine operated under less severe operating conditions. Research Octane Number affects low-to-medium speed knock and engine run-on. Research Octane is represented by the designation R in the  $(R+M)/2$  equation and is the higher of the two numbers.

**Olefins:** a gasoline component resulting from several refining processes. Examples are ethylene, propylene, butylene. Olefins often contribute to the formation of gum and engine deposits.

**Phase Separation:** the formation of layers due to the presence of water within a low level alcohol-gasoline blend, with most of the hydrocarbons in the upper layer and water, alcohol, and some aromatic hydrocarbons in the lower level. This condition can lead to driveability problems.

**Reid Vapor Pressure (RVP):** a method of determining vapor pressure of gasoline and other petroleum products. Widely used in the petroleum industry as an indicator of the volatility (vaporization characteristics) of gasoline.

**Solubility:** the amount of a substance that will dissolve in a given amount of another substance and is typically expressed as the number of parts by weight dissolved by 100 parts of solvent at a specified temperature and pressure or as percent by weight or by volume.

**Spark Advance:** the optimal spark setting, an operating parameter dependent on the rate of flame development and propagation within the combustion chamber.

**Stoichiometric:** characterized by, or being a proportion of, substances or energy exactly right for a specific chemical reaction with no excess of any reactant or product, i.e., chemically correct.

**Stoichiometry (of fuel/air):** the proportion required between fuel and air for a specific fuel to allow complete combustion of the chemical reactions to occur (i.e., the proportions that are exactly right).

**TAME (Tertiary Amyl Methyl Ether):** an ether formed by the reaction of methanol and either isoamylene or isopentalene.

**Terne Metal:** sheet iron or steel coated with an alloy of about 4 parts lead to 1 part tin.

**Toxicity:** the quality, state, or relative degree of being poisonous.

**Vapor/Liquid (V/L) Ratio:** a test to determine a fuel's tendency to vapor lock (i.e., the temperature required to create a V/L ratio of 20).

**Vapor Lock:** the inability of a fuel system to supply the required quantity of fuel to the engine because of the formation of excessive vapor in the system.

**Volatility:** term used to describe a gasoline's tendency to change from liquid to vapor.

**Watt (W):** the common base unit of power in the metric system. One kilowatt (1 kW) = 100 W; one kilowatt hour (1 kWh) = the amount of power equivalent to 1 kW and consumed for one hour.